Bioretention Workshop

Larry S. Coffman, Associate Director

Programs and Planning Division

Prince George's County

Department of Environmental Resources

Email: lscoffman@co.pg.md.us

Phone: 301-883-5834

PRINCE GEORGE'S COUNTY MARYLAND

SEMPER EADEM

County Executive

Jack B. Johnson

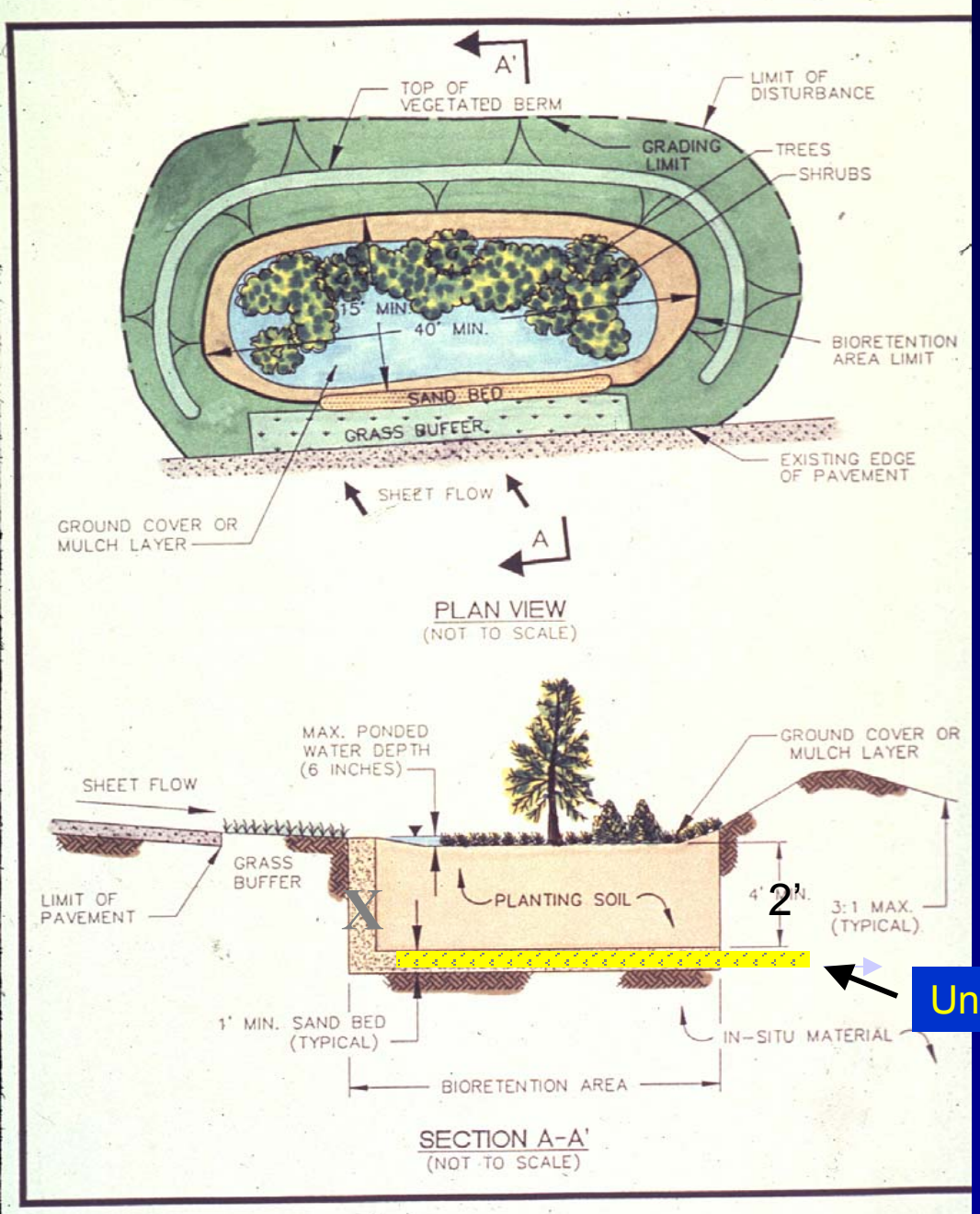
What is Bioretention?

"Filtering stormwater runoff through a terrestrial aerobic (upland) plant / soil / microbe complex to remove pollutants through a variety of physical, chemical and biological processes."

The word "bioretention" was derived from the fact that the biomass of the plant / microbe (flora and fauna) complex retains or uptakes many of the pollutants of concern such as N, P and heavy metals.

It is the optimization and combination of bioretention, biodegradation, physical and chemical that makes this system the most efficient of all BMP's

Bioretention



PARKING EDGE AND PERIMETER WITHOUT CURB

- Shallow Ponding - 4" to 6"
- Soil Depth 2' - 2.5'
- Sandy Top Soil
  - 65% Sand
  - 20% Sandy Loam
  - 15% Compost
- Under Drain System
- Plant Selection

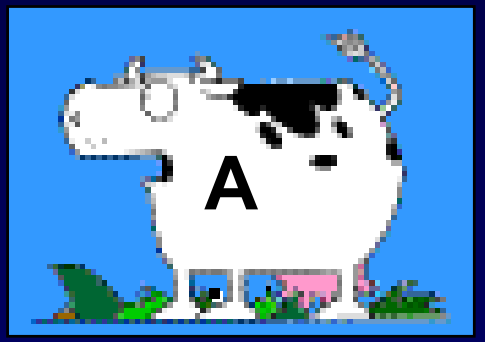
Under Drain

Aesthetic Value / Habitat Value

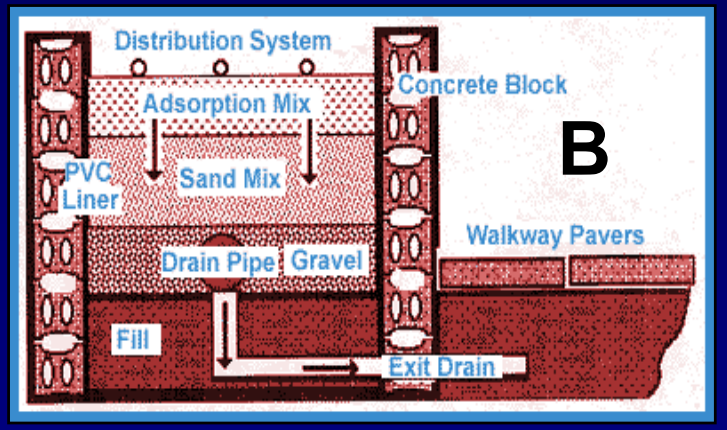
Property Value / Low Cost

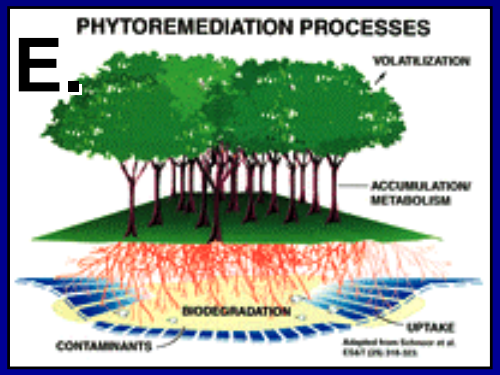
Low Maintenance

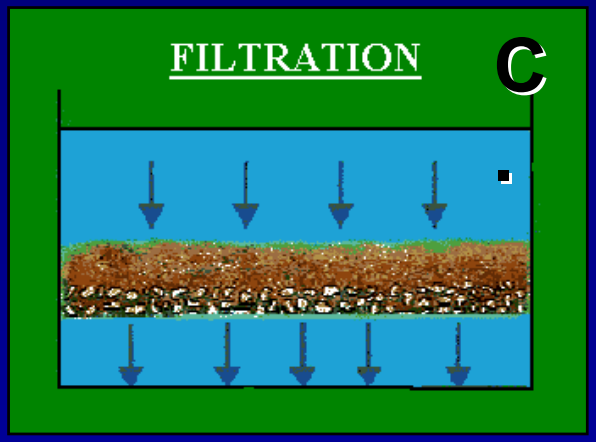
Background



- Historical Use of Plant / Soil Filters
  - Agriculture (1 cow / 1.17ac)
  - Wastewater Treatment
  - Water Supply
  - Bioremediation
  - Phytoremediation







Background

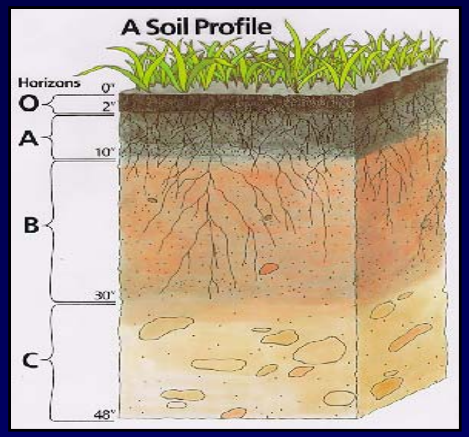
Soil Ecosystem Functions

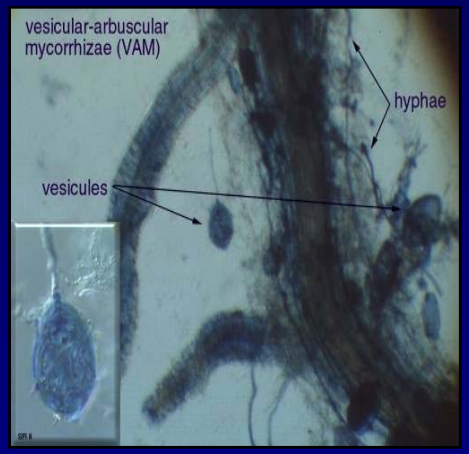
Physical / Chemical / Biological

1. *Hydrology*
   storage / evaporation / recharge / detention
2. *Storing Cycling Nutrients (bacteria / fungi)*
   phosphorous / nitrogen / carbon
3. *Plant Productivity (vigor)*
4. *Water Quality*

   filter / buffer / degrade / immobilize
   detoxify organic and inorganic materials

"Most diverse ecosystem in the world"






Rain Gardens
MAY 21 2001

Design Features

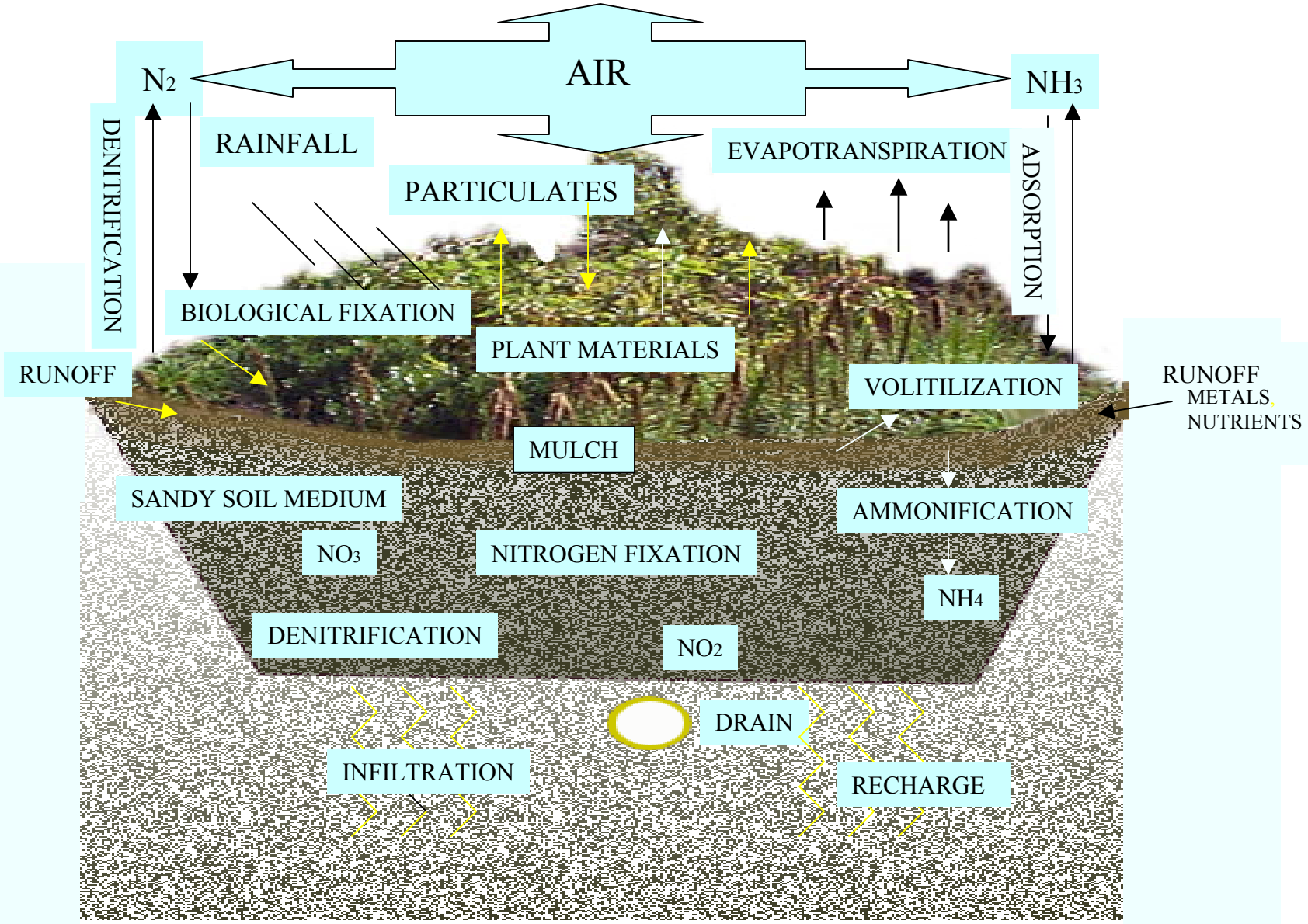
- Upland Terrestrial Forest / Meadow
  - Mulch
  - Shallow Ponding Area (4” to 6”)
  - Plants (facultative)
  - Fertile Top Soil (Sandy / 2.5’)
  - Good Drainage
    - Under Drains
    - High Flows / By Pass / Off Line

Other Interesting Study Findings

- Mulch and Metals
- Plants and Metals
- Capacity / Longevity of the System
- Time For Reactions (Residence Time)

Pollutant Removal Mechanisms

- Soil / Physical / Chemical
  - Sedimentation
  - Filtration
  - Adsorption
  - Precipitation
  - Humic / Clays / Silts
    - Electrostatic / Ion Exchange

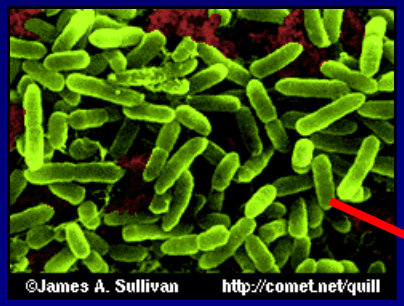


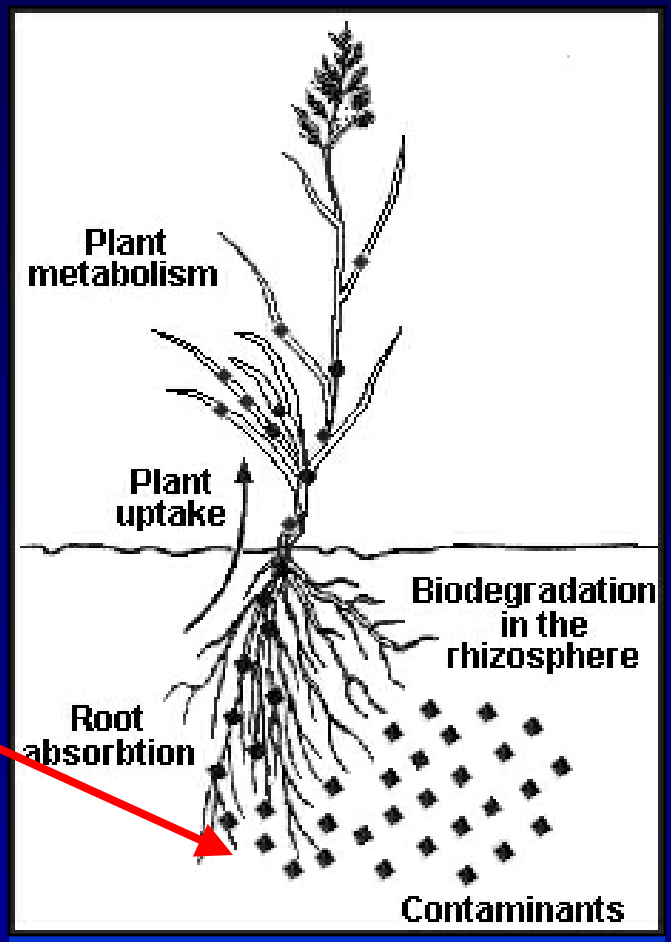
NITROGEN CYCLE FOR BIORETENTION

Uplands Pollutant Removal

Plants / Soil Flora -Fauna / Soil Chemistry

- Phytoremediation
  - Translocate
  - Accumulate
  - Metabolize
  - Volatilize
  - Detoxify
  - Degrade
    - Exudates
- Bioremediation
- **Soils**
  - **Capture / Immobilize Pollutants**






Swallowtail on Spiked Gayfeather
Liatris spicata

Value of the Plants

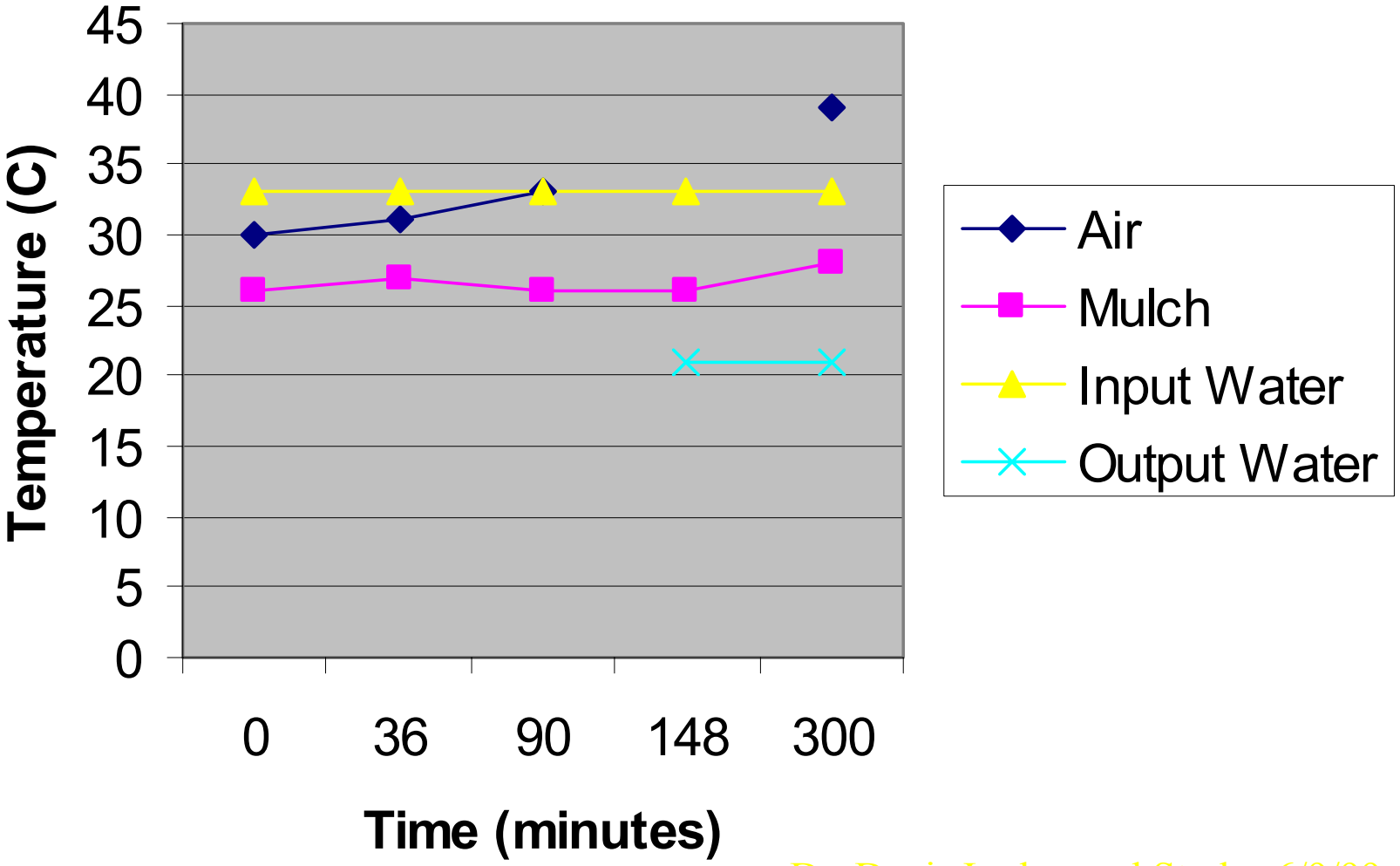
Aesthetics

Habitat

Treatment

Air Pollution

Bioretention Temperature Data



Dr. Davis Inglewood Study- 6/9/99

Percent Removal

(Bench Models / Field Summary)

	Cu	Pb	Zn	P	TKN	NH4	NO3	TN
Upper	90	93	87	0	37	54	-97	-29
Middle	93	99	98	73	60	86	-194	0
Lower	93	99	99	81	68	79	23	43

Dr. Allen Davis, University of Maryland, Department Civil Engineering
Derek Winogradoff, Senior Engineer, Prince George's County, Md.

- Bioretention in a Box
- Artificial Runoff Solution
- Varied Flow Rates
- Varied Concentrations (1/2 - 2x)

Pollutant Removal

Oil and Grease Over 95% Removal

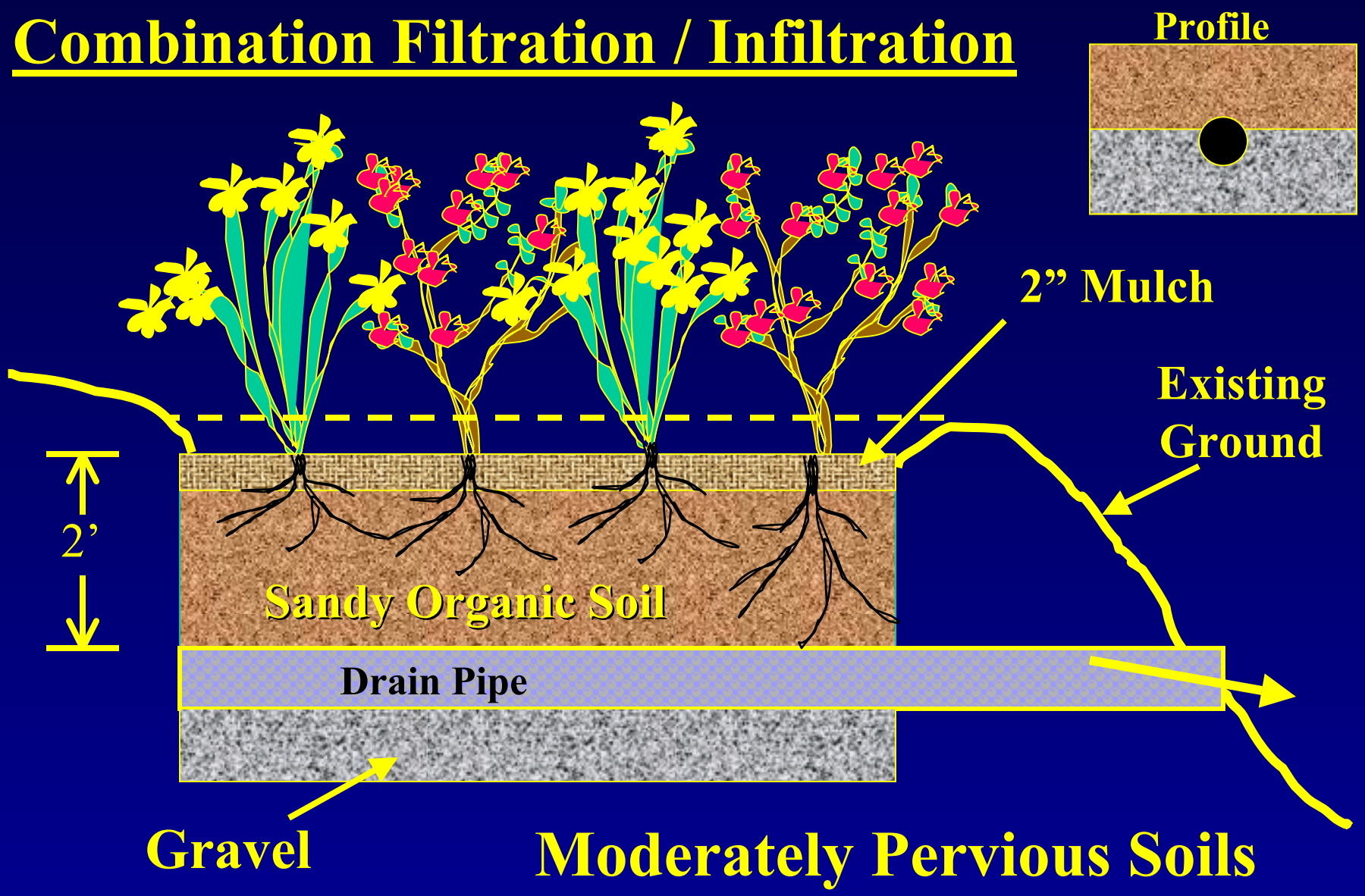
Dr. Eric Seagren - University Maryland

Removal Mechanism

Capture by mulch / soil / bacteria

Metabolized by bacteria

Combination Filtration / Infiltration



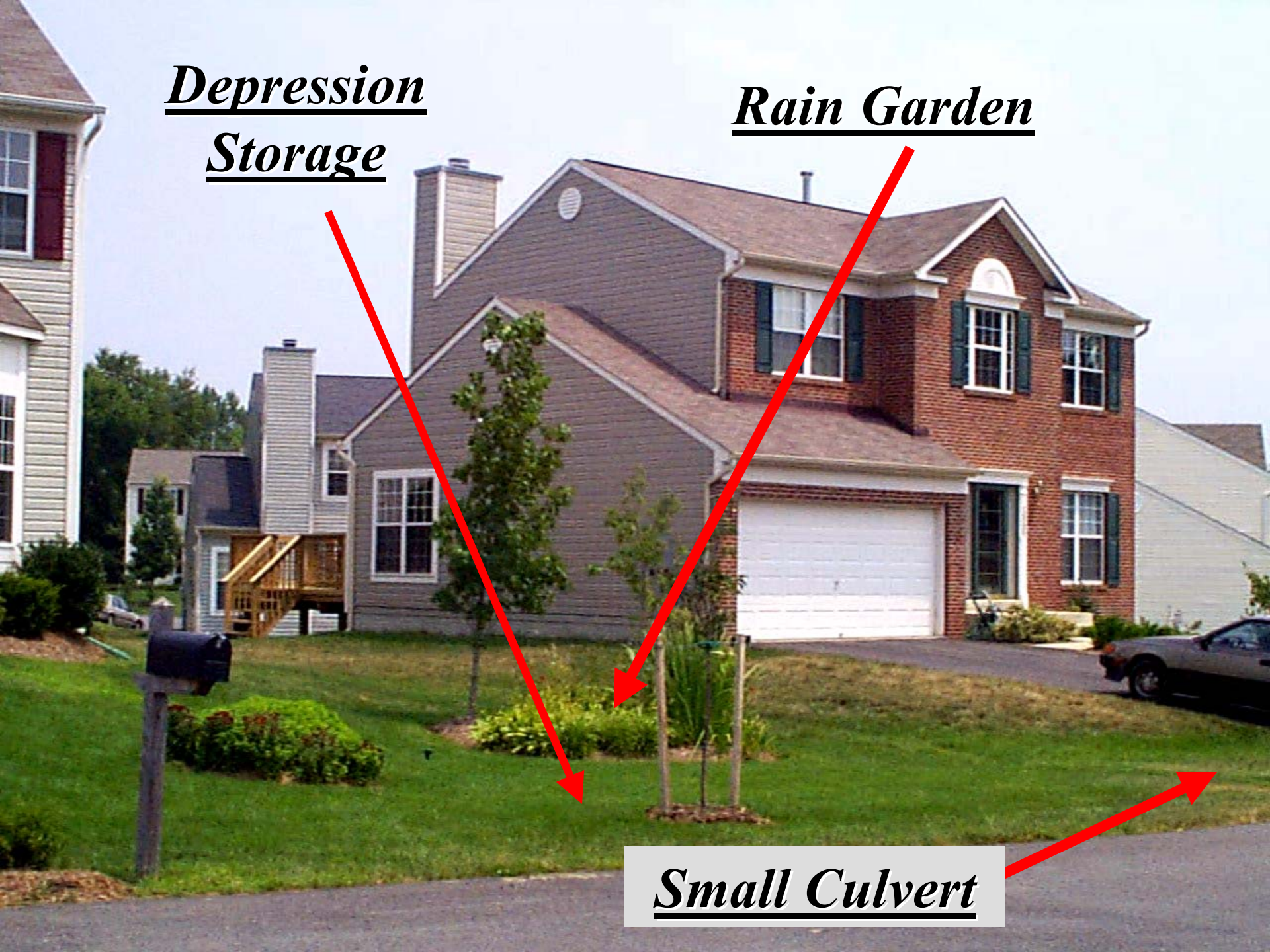
Bioretention Applications


High Flow Rate Filter and Infiltration
Treats 90% of Total Annual Volume

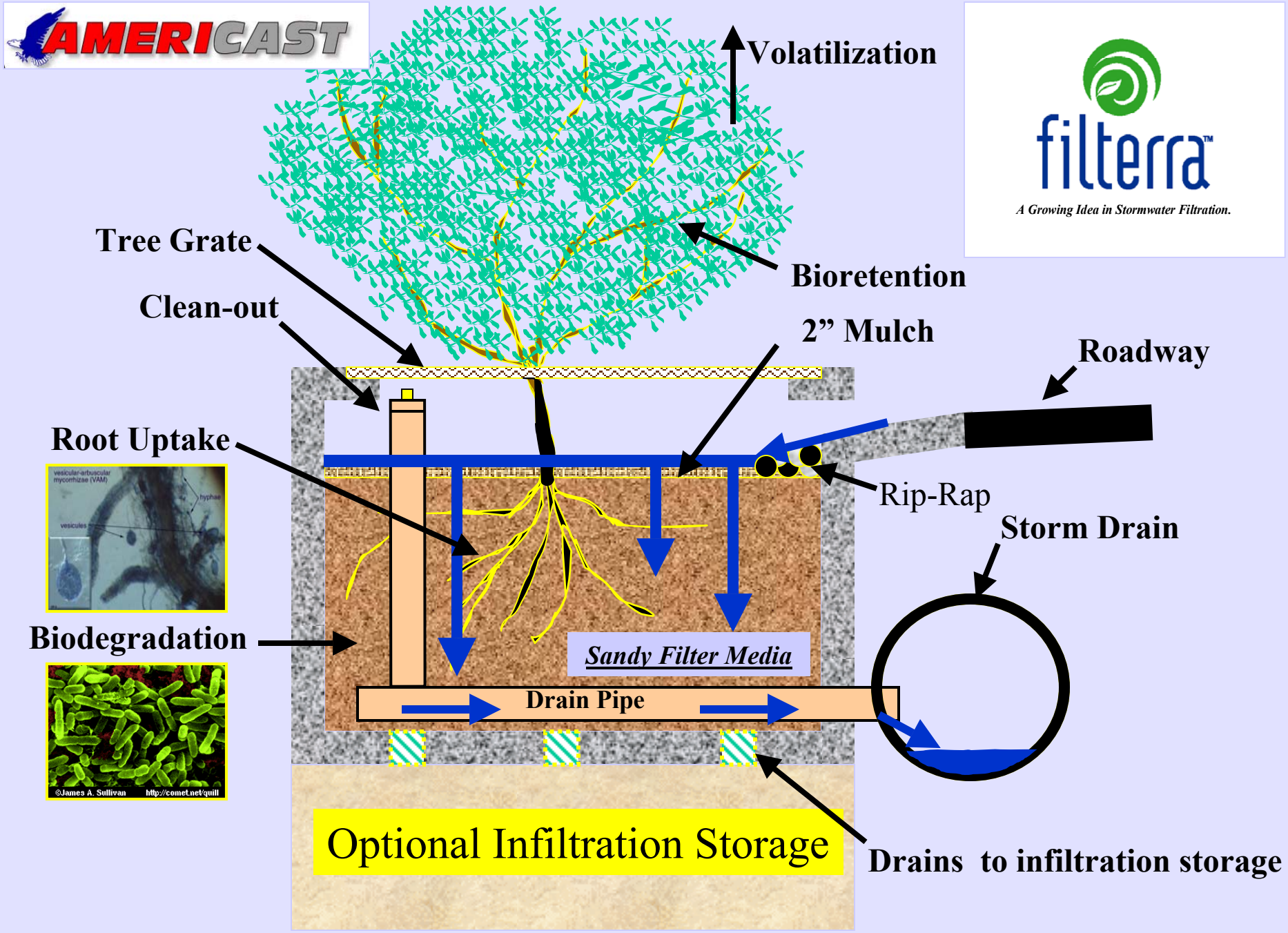

'88 4 24


'88 3 25


'88 5 5

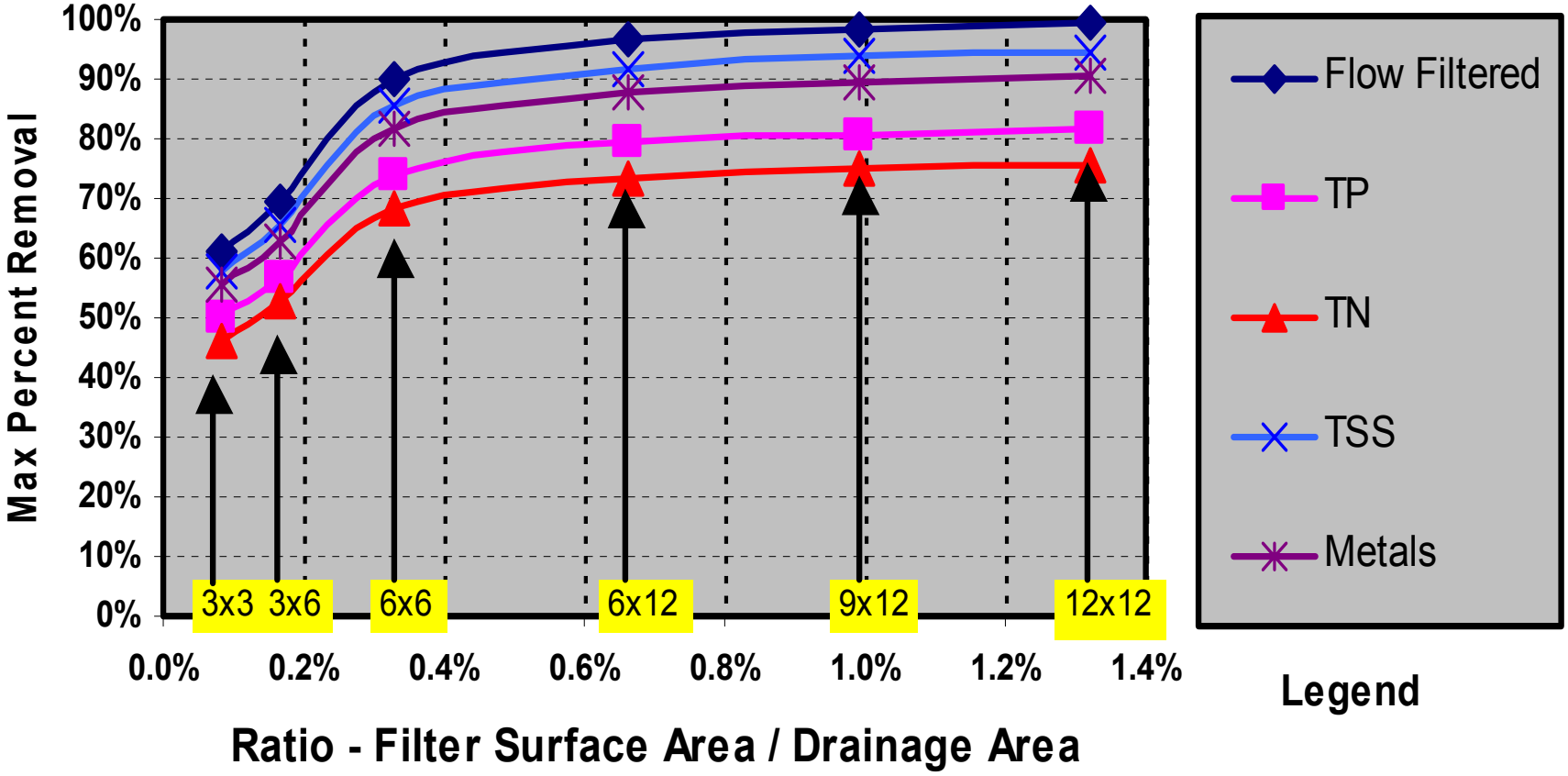

Depression Storage
Rain Garden
Small Culvert

Transportation Departments


AMERICAST
Volatilization
filterra
A Growing Idea in Stormwater Filtration.
Tree Grate
Clean-out
Bioretention
2" Mulch
Roadway
Root Uptake
Rip-Rap
Storm Drain
Biodegradation
Sandy Filter Media
Drain Pipe
Optional Infiltration Storage
Drains to infiltration storage

Performace

Per 1/4 Acre Impervious Surface Area



Virginia

Examples of Bioretetnion and Rain Gardens DEQ / DCR

Larry Gavan


Rain Garden in an office building project along the
G.W. Parkway. (Looking East)

Rain Garden in a median strip of a townhouse project just inside the beltway. Please note the depressed curb and grate inlet structure,

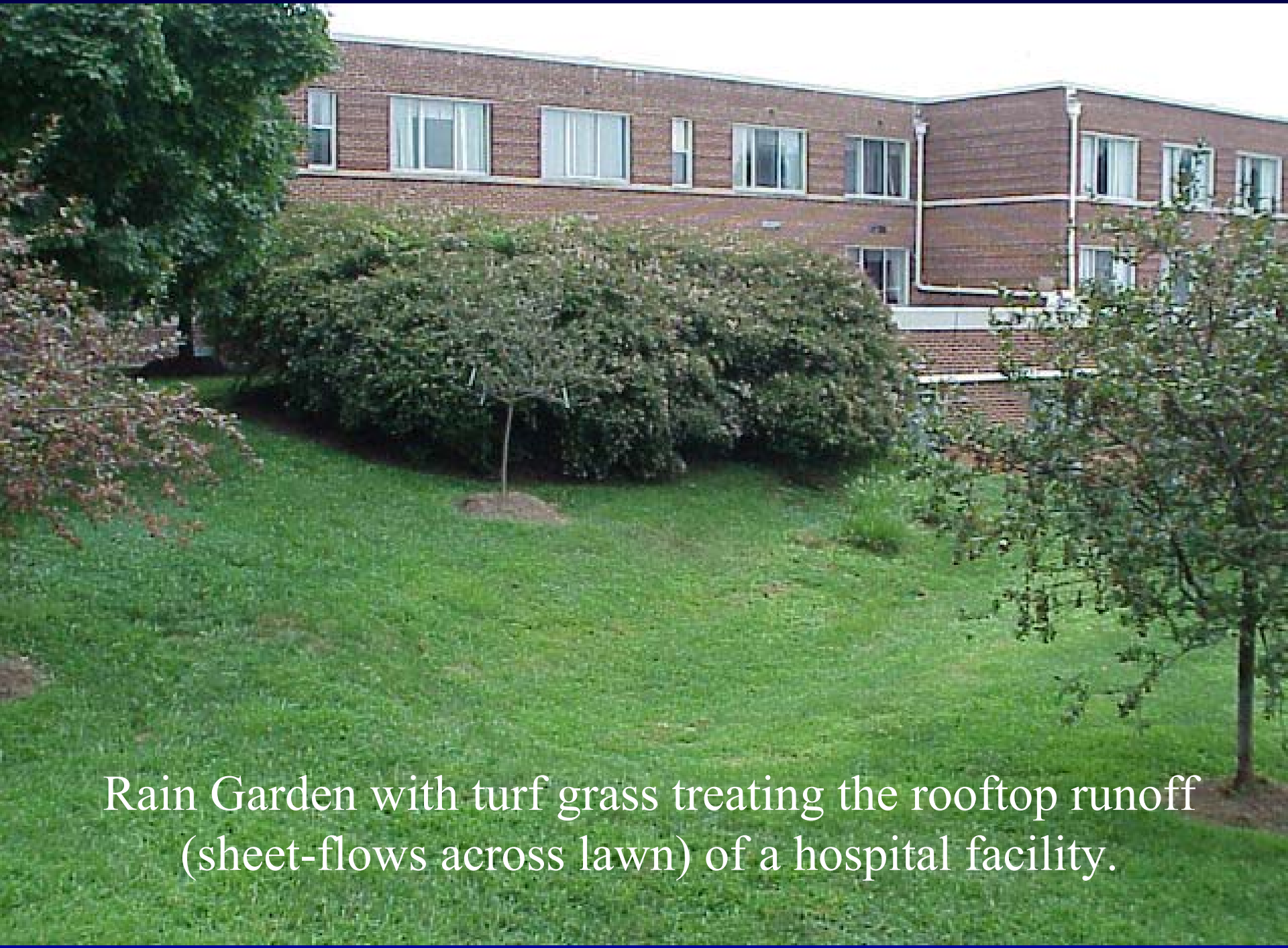
Rain Garden (in use) located in the entrance median to a town house Project.

Rain Garden (in use) in the front yard of a town house project.

Rain Garden on a commercial project with turf grass near I-395 and Edsall Road.

The first Rain Garden in Virginia, located in a turning circle in front of St. Stephens School, Alexandria.

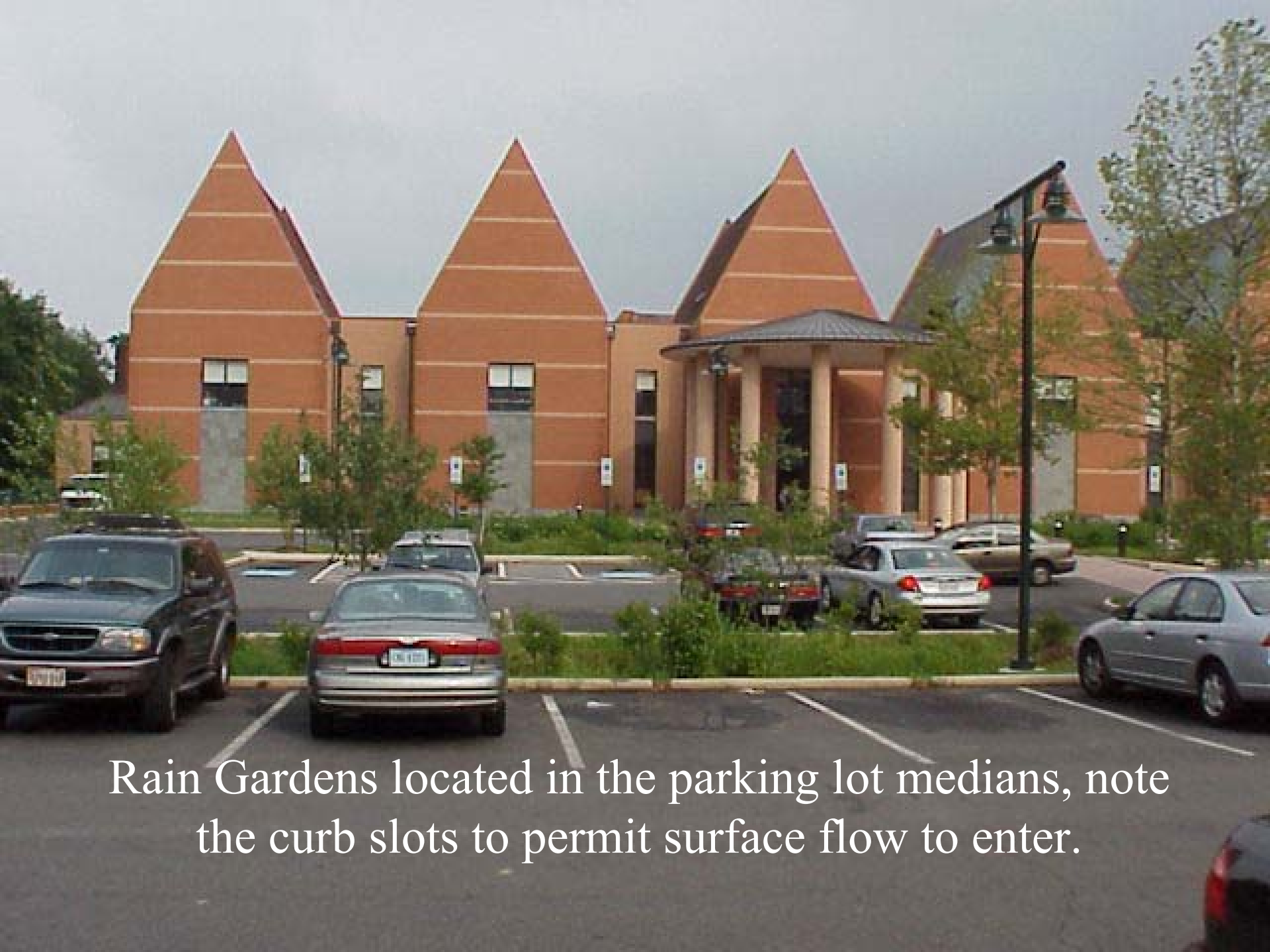
St. Stephens Rain Garden- 5 years later.



Rain Garden with turf grass treating the rooftop runoff (sheet-flows across lawn) of a hospital facility.

Rain Garden (in use) in a highly landscaped commercial site along Route. 1.

Rain Gardens used through-out the Alexandria Central Library to treat all impervious runoff



Rain Gardens located in the parking lot medians, note the curb slots to permit surface flow to enter.

Failures

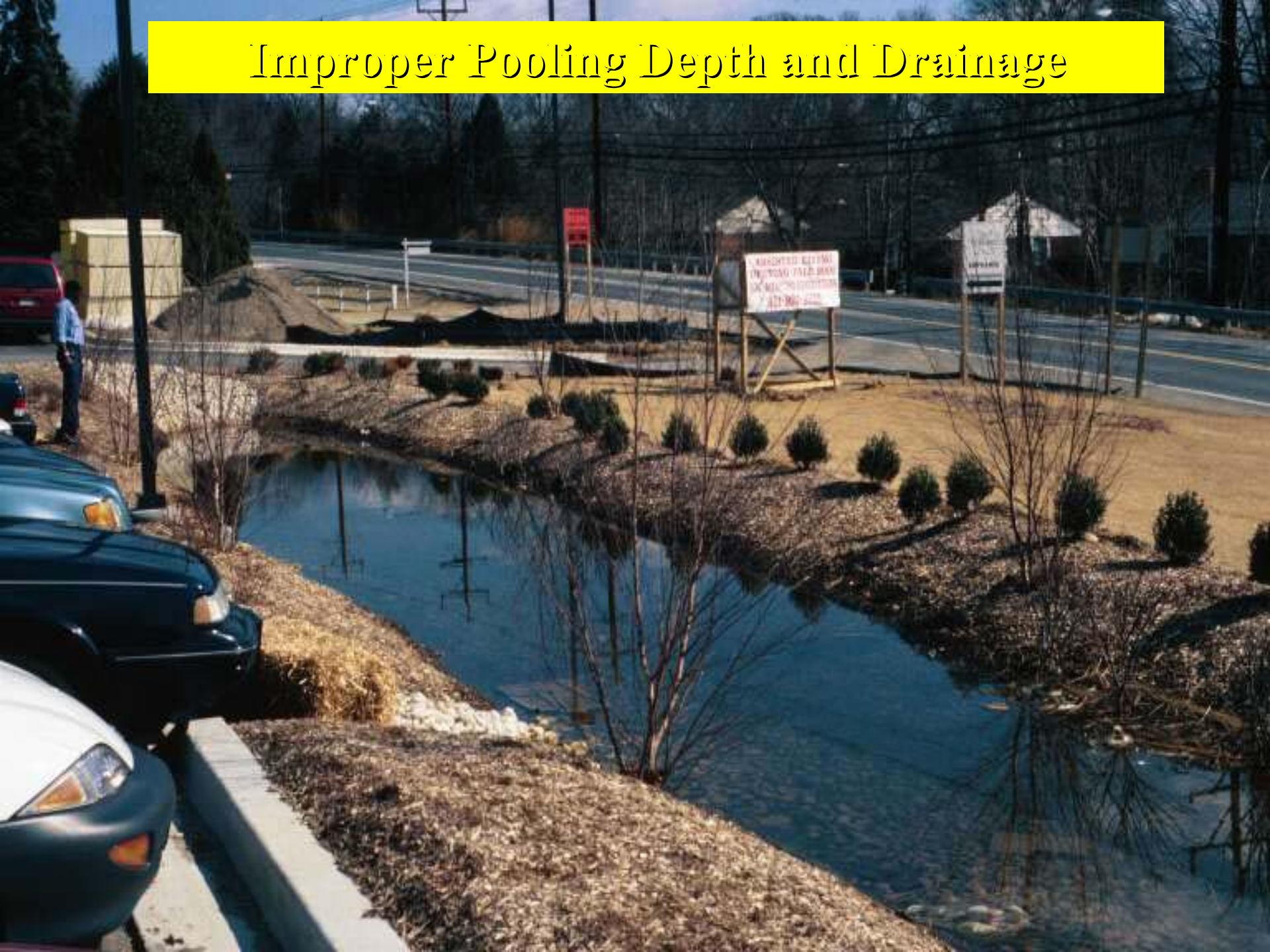
Plant Density

Plant Location


NOT
TER


HANDICAPPED
PARKING
ONLY

Improper Pooling Depth and Drainage



WHAT'S NATIVE?

Maintenance


TYMCO
210
098879


Maintenance Cost - $200 / Year


SPORTS
AUTHORITY

Education &Training

Consultants

Reviewers

Builders

Contractors

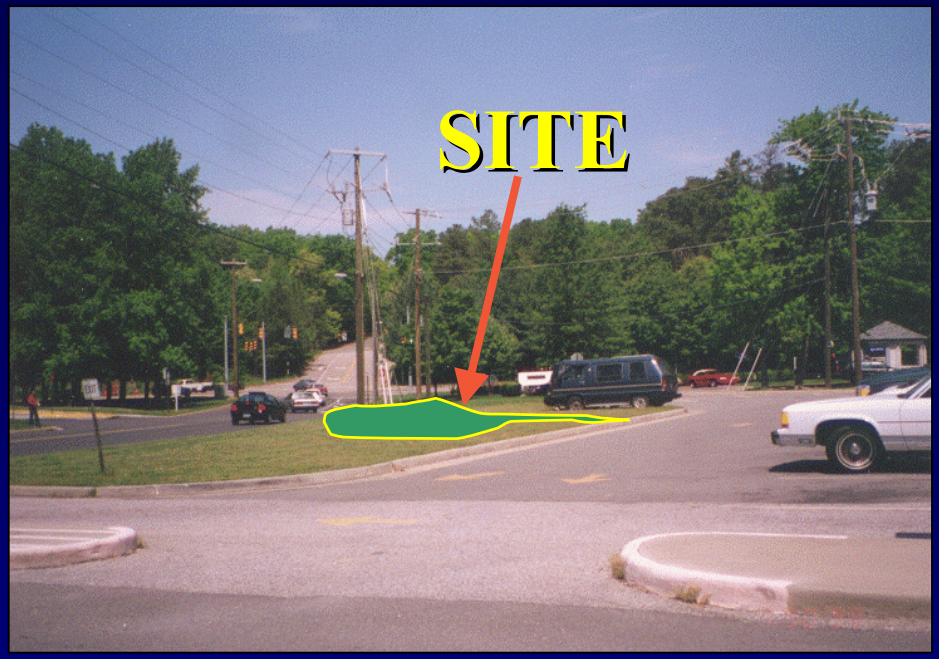
Inspectors

Property Owners

Institutions

Costs

Bioretention Facility Site



Stormwater Inlet Point

Note: Green shapes approximate location of facility. The facility extends off the photo to the left as well.

Facility to be located in large grass island between roadway and parking lot.
Facility has drainage area of 0.29 acres, nearly all impervious.

Bioretention Facility Design

- **Estimated Costs:**
  - **Piping & Drainage** **$1,500**
  - **Grading & Soil Preparation:** **$695**
  - **Plants & Planting Costs:** **$1,500**
  - **TOTAL ESTIMATED COST:** **$3,695**
  - **Cost is $12,741 per acre of drainage area served**
- **Estimated flow reductions to storm sewer of 25+% in average summer rainstorms**
- **Flow storage provided for 400 cf. of water, which is approximately the expected volume of runoff from an average summer rainshower producing 0.4” of precipitation**
- **In heavy storms, flow will fill bioretention and then bypass to existing storm sewer system**

UNITED STATES POSTAL SERVICE

Bioretention Benefits

- **Restores Hydrologic Functions**
- **Economically Sustainable**
  - **Efficient Use of Space / Reduced Infrastructure**
  - **Property Value**
  - **Scale of Maintenance Burdens**
  - **Reduces Development Costs**
- **New Tool for Urban Retrofit**
- **Practical / Simple / Universally Applicable**